INFORMATION TECHNOLOGY PERSPECTIVES

MODS:
The Metadata Object Description Schema

Rebecca S. Guenther

Prefatory Commentary from the Editor

Fortunately, the library world is evolving very rapidly. An alphabet soup of initiatives has surfaced in the last few years, many of which may be with us for a long time. These include SPARC, DLF, OAI, W3C, XML, RDF, OWL, DCMI . . . This article is about one of the more recent—MODS, Metadata Object Description Schema, and it may be helpful to provide some background as to why it is important enough to include here. First, for the noncataloging specialist, what is it? In brief, MODS is a drastically simplified set of conventions for cataloging. It may be applied to anything, but many will see it as most useful in the Web environment. A second question: Why is it necessary? I would say primarily because of drawbacks in the Dublin Core.

Rebecca Guenther is one of the designers of MODS. She has spent the greater part of her career at the Library of Congress in standards work, was present at the inception of the Dublin Core, and has been active in its long evolution. Her article, while giving an overview of MODS, also details the reasons why the Dublin Core is inadequate for describing complex digital objects, at least from the library perspective.

There are three major causes that can be adduced for the less than enthusiastic adoption in the library world of the Dublin Core, especially in the arena where it should have been most successful: as a tool for describing Web resources by libraries. First is its incompleteness. After seven years in development, some of its fifteen elements (now sixteen we are told by Ms. Guenther) have yet to receive even cursory qualification or refinement, a precondition for serious use for library applications. The primary miscreants: those elements dealing with the agents responsible for a resource, namely, the Creator, Contributor elements. Along with the Publisher element, also suspect, these have been the object of endless discussions in the Dublin Core community, without issue as nearly as I can make out. They remain as they were initially proposed, naked and unqualified, and as a consequence, inadequate for many uses.

A second indicator of limited success is the absence of a set of accepted (or acceptable) instructions for using the partially completed qualified Dublin Core that has been issued by the Dublin Core Metadata Initiative (DCMI), the title of the organization controlling its evolution. This lack is as lamentable as it is inexplicable. What it causes, among other sad consequences, is the reinvention at every new use, and in every adopting community, of a local set of instructions, a sorry waste of time, as well as a guarantee of inconsistent use in the application. And this for a standard that is notoriously vague and hard to apply.

The third (and primary) indicator of limited success is a result of the first two: its slow adoption, particularly for library applications. Let me state my belief clearly: because the Dublin Core is incomplete and undocumented, it is expensive and difficult to use, and thus fails to provide a convenient, easy to use standard for creating usable resource descriptions for Web objects.

You may very well ask, why should we care? And I would counter: Do libraries have the responsibility for providing access to patrons of knowledge objects on the Web? If your answer is, no, others (specifically, Google) are doing an adequate job, skip this article; indeed, skip 21st century librarianship. If you answer yes, another question follows: How is this to be done? That is the role the Dublin Core might have played, at least for library practitioners. MODS may offer a better solution. It attempts to provide richer resource descriptions than Dublin Core has been able to do even in its qualified form.

One additional point. MODS is a descriptive metadata format designed to be used with The Metadata Encoding and Transmission Standard, (METS), developed as an initiative of the Digital Library Federation with help from the library and information science communities. Its purpose is to define a means of using XML schemas for the encoding of different forms of metadata. Descriptive metadata is an important part of a METS object but other schemas may also be used and packaged with the METS object. More on this in a subsequent issue.

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MODS: The Metadata Object Description Schema

Rebecca S. Guenther

With the flexibility of XML and its rapid adoption as an encoding language, the Library of Congress' Network Development and MARC Standards Office is looking to future needs in the library and related communities for descriptive metadata standards. The office has developed two XML schemas for descriptive metadata, based on MARC data elements and semantics: the full MARCXML format that provides a lossless conversion from MARC in the ISO 2709 structure to an XML syntax, and the Metadata Object Description Schema (MODS), which includes a subset of MARC elements, a simpler MARC that uses language-based, rather than numerical, tags. It is particularly applicable to digital library objects that require rich descriptions compatible with existing ones in library catalogs, but not as complex as full MARC, and thus easier and quicker to create.

Reasons for MODS Development

The Metadata Object Description Standard (MODS) was developed by the Library of Congress' Network Development and MARC Standards Office in consultation with interested experts to satisfy the expressed need for an abbreviated XML version of MARC 21. It seems clear that XML is being increasingly deployed in computer applications, particularly on the Web as a richer, more flexible alternative to HTML. Many have expressed the need to move to XML for metadata in libraries and other cultural institutions. MARC being perhaps the oldest metadata standard designed for use in computers, it is appropriate for an XML version to be investigated.

At regular intervals librarians question whether MARC 21 is appropriate in this century and changing environment. The arguments that MARC is obsolete often show confusion over the definition of "MARC." If that argument pertains to the syntax as detailed in the ISO standard 2709, then moving toward XML might be a logical progression.[1] If MARC is the rich set of metadata elements as defined in the *MARC 21 Format for Bibliographic Data*, it continues to be useful as a standard that enables complex and rich search and retrieval of millions of bibliographic records, and moving the expression of the elements to XML syntax is appropriate.[2]

The other complaints frequently expressed about MARC 21 are that it is too big and complex, there are too many fields to choose from, fixed field coding is cumbersome, and the identification of fields using numeric tags is difficult to learn and not user friendly. Thus there is a desire for a smaller set of data elements that are simpler to apply. Efforts like the Dublin Core Metadata Initiative have attempted to satisfy these needs, although that effort is intended to satisfy a broader range of purposes and communities than MARC 21 does.[3]

In considering these various comments about future use of MARC, the Library of Congress, with input from interested experts, embarked on the development of MODS, which is an XML schema that includes a subset of data elements derived from MARC 21. It is intended to carry selected data from existing MARC 21 records as well as to enable the creation of original resource description records.

Advantages of MODS

MODS should complement other metadata formats and should provide an alternative between a very simple metadata format with a minimum of fields and no or little substructure (for example, Dublin Core) and a very detailed format with many data elements having various structural complexities such as MARC 21. MODS has a high level of compatibility with MARC records because it inherits the semantics of the equivalent data elements in the MARC 21 bibliographic format. Thus, it is richer than Dublin Core and more compatible with library data than either the Dublin Core or ONIX, which was developed for the book industry.[4] At the same time, it is much simpler than the full MARC format (either as ISO 2709 or full MARCXML), and more "friendly" because it uses language-based tags that can be easily understood by anyone dealing with the "raw" record.

Features of MODS

Most elements defined in MODS have equivalents in the MARC 21 bibliographic format. In the MODS XML schema, the documentation sections specify where the semantics for the element can be found in MARC 21. In addition, the Library of Congress has made available mappings between MARC and MODS and vice versa.[5] Since MODS elements inherit the semantics of MARC elements, there is a high degree of compatibility with MARC records: an element in MODS has the meaning detailed in the MARC 21 bibliographic format.

In MODS some elements in MARC have been repackaged, particularly in cases where several data elements are brought into one. For example, the MODS element genre uses controlled values gathered from various MARC elements, many of them from fixed fields. The Library of Congress has made available a controlled list of genre values found in various places in the MARC 21 bibliographic format to be used with the MODS genre element.[6] Another kind of repackaging occurs with the concepts of issuance and aggregation, both of which occur in the MARC element Leader/07. These two concepts are represented in MODS as two elements: issuance, with the values of monographic or continuing, and as the attribute collection in the typeOfResource element.

MODS, like MARC 21, does not assume the use of any particular cataloging code. However, it does, like MARC, accommodate record content that is full AACR2 with authoritative name and subject headings, uncontrolled by cataloging rules, or anything in between.

Since MODS is a subset of MARC, decisions were made about which elements to include, about which could be combined with other elements to form a single element, and about which would be dropped altogether. For instance, there are numerous types of relationships that are expressed in the MARC 76X-78X linking entry fields. These are carried in MODS under relatedItem with a type attribute to express the type of relationship. Not all relationships in MARC are given type values, and in some cases they are combined into a single type. An example is field 770 (Supplement/Special Issue Entry) and 774 (Constituent Unit Entry): both are mapped to type="constituent". In addition, some elements that have multiple values in MARC have not retained all of their values, particularly when fine distinctions were made.

Certain MODS elements define concepts that recur in more than one element as subelements. Since the underlying encoding is in XML, these are defined as XML complex types, which allows the use of the same definition for multiple elements. Thus, the subelements may be reused within different main elements. The primary elements used in this way are "name," "identifier," and "titleInfo." These are used as both elements and subelements. For example, "name" can be the primary name associated with the resource, or a name associated with a related item; in MODS, both use the same definition. This concept is certainly present in MARC 21 but not as consistently as in MODS.

Prospective Uses for MODS

The need for a metadata standard such as MODS has been expressed by members of the digital library and related communities as they attempt to implement projects involving search and retrieval, management of complex digital objects, integrating metadata from library databases with other non-MARC sources, and other functions.

The Z39.50 International Next Generation (ZING)'s Search/Retrieve Web Service (SRW) is a proof-of-concept initiative to enable development of value-added search and retrieve applications such as the scholar's portal that will integrate access to various networked resources.[7] It is built on Z39.50 along with web technologies—XML, SOAP/RPC, and HTTP. It defines a search service that specifies metadata schemas for retrieval. Since it uses XML, an XML metadata schema is needed, and one compatible with library data such as MODS would be desirable.

The Open Archives Initiative Protocol for Metadata Harvesting harvests MARC records from multiple systems and makes them available widely.[8] Generally the records have been available in MARC (using MARC tagging and syntax in MARCXML) or Dublin Core simple. The Library of Congress has incorporated MODS as an alternate format for its over 100,000 metadata records for items digitized for American Memory that are harvested. (Items represented include books, maps, photographs, early movies, sheet music, and printed ephemera.) This will allow for the export of richer metadata than the Dublin Core record, which drops much of the metadata, but provides simpler data than MARC 21.

MODS may also be used for original resource description that allows for rich description that is generally compatible with existing library data and is expressed in XML syntax. Because it includes a subset of MARC fields and repackages some of them, it is particularly useful for technician input.

Relationship with MARC and MARCXML

Since MODS is defined as a subset of MARC 21, it allows for a conversion from MARC 21 to those fields that are represented in MODS, while the content in other MARC 21 fields may be dropped or carried in a less specific manner. This is detailed in the mappings provided at the MODS Web site <http://www.loc.gov/standards/mods/>. Since the MODS schema is a subset, it does not target "round-tripability" with MARC 21. In other words, an original MARC 21 record converted to MODS and then back to MARC 21 may lose some of its tagging or even some data. In addition, the reconversion into MARC 21 may not place the data in exactly the same field that they started in, because a MARC field may have been mapped to a more general one in MODS. The data itself will not be lost, only the detailed identification of the type of element it represents. In other cases the element in MARC may not have an equivalent element in MODS, and then data will be lost when converting to MODS.

When an XML schema is desired that does not result in any data loss, the MARC 21 XML schema may be used.[9] This schema allows for the expression of a full MARC record in XML with no data loss. For any conversion between MARC in ISO 2709 format and MODS, it is expected that the record would first go through a conversion to MARCXML before a transformation to the subset that is MODS. The Library of Congress is providing tools for the conversion from MARC 21 to MARCXML with a further transformation to MODS.

Comparison with Dublin Core Element Set

A comparison between the Dublin Core metadata element set (DCMES) and MODS differs depending upon whether one is using Dublin Core simple or Dublin Core quali-

fied. In the presentation here, the comparison is generally in terms of Dublin Core quali-fied. The Dublin Core Metadata Element Set has sixteen main elements (this includes the new element "audience," which was added as a result of a proposal by the DCMI-Education Working Group in October 2001) and MODS has twenty top-level elements. In addition, Dublin Core qualified has twenty-eight additional subelements that refine elements; MODS has forty-seven subelements (note that subelements under more than one top level element are only counted once). These additional subelements provide for a richer description. MODS also has substructure that Dublin Core does not, as is dis-cussed below, providing further richness. In some cases, for example, the title element, there is a close correspondence between the Dublin Core element and a MODS element. However, the semantics of many Dublin Core elements are broader than those in MODS, which inherit the MARC semantics. Rather than compare the sets element by element, this discussion will focus on a few elements that illustrate both the richness of MODS and its greater compatibility with MARC, compared with the Dublin Core.

Table 1

Element Comparison Between MODS and Dublin Core

MODS	Dublin Core
titleInfo [mandatory]	Title
name	Creator
	Contributor
typeOfResource	Type
genre	
publicationInfo	Publisher
	Date
physicalDescription	Format
language	Language
abstract	Description
tableOfContents	Description
note	Description
subject	Subject
classification	Subject
relatedItem	Relation
identifier	Identifier

MODS	Dublin Core
targetAudience	Audience
cartographics	Coverage
accessConditions	Rights
No comparable Element in Dublin Core	
extension	
recordInfo [not repeatable]	
location	

Creator and Contributor. The Dublin Core element set includes two elements for names associated with the resource: Creator and Contributor. Dublin Core distinguishes between these based on the nature of the contribution made to the resource, whether primary or secondary. The distinction between primary and secondary contributors is not made in the same way in MARC. In MARC, people often map Creator to the 1XX fields (Main Entry—Personal Name, Main Entry—Corporate Name, etc.) and Contributor to 7XX (Added Entry—Personal Name, etc.), but this mapping is inadequate, because the distinction between these fields does not depend upon the primary or secondary nature of a person's contribution to the resource (a name in 7XX could have as primary a role as one in 1XX), but on the cataloging rules regarding main entry. (Most library systems include 1XX and 7XX in the same index, so there is no apparent distinction in their use.) MODS combines the 1XX and 7XX into one element "name." Although the distinction between Creator and Contributor in Dublin Core concerns the role played by the entity, DCMES currently has no mechanism to indicate what that role is (although this has been discussed for several years). MODS allows for a role subelement to indicate the entity's relationship to the resource.

In addition, Dublin Core does not allow for distinguishing between types of name (i.e., personal, corporate). Many have argued that this is unnecessary, but since MARC has separate blocks of fields that are dependent upon the type of name, MODS allows for a type associated with the name element. The ability to distinguish types of names has been found useful in library systems for effective searching and indexing of names. It is interesting to note that the ALA Machine Readable Bibliographic Information Committee (MARBI) considered a proposal several years ago to define an uncontrolled name field 720 that did not specify the type of name; in that discussion the participants felt that it was useful to retain the information, if it is available, that identifies a personal name, so they added an indicator value to express this. The field was intended for better mapping between MARC and Dublin Core.

As a result the mapping between MARC and MODS allows for greater compatibility between the two. MODS also allows for an affiliation associated with the name, a display form (i.e., unstructured form that might be used for display), a description (an element not in MARC bibliographic), and a link to an authority record. DCMI has not yet approved any qualifiers associated with Creator or Contributor, so no substructure or element refinements are possible.
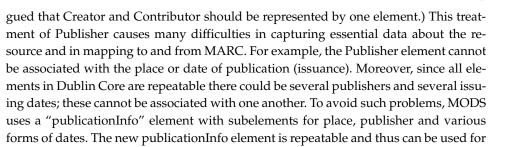
Publisher.

Table 2

Comparison of MODS PublicationInfo with Dublin Core Publisher, Date

MODS

PublicationInfo
    Subelements [ordered]
        placeCode
            Attribute: authority (marc, iso3166)
        Place
            publisher
            dateIssued
                Attributes: encoding (w3cdtf, iso8601, marc); point start, end)
            dateCreated
                Attributes: encoding (w3cdtf, iso8601, marc); point start, end)
            dateCaptured
                Attributes: encoding (w3cdtf, iso8601, marc); point start, end)
            edition
            issuance (continuing, monographic)
            frequency

DUBLIN CORE (QUALIFIED)
Publisher
    no Subelements
Date
    Subelements ("element refinements"; treated in Dublin Core as elements)
        Created
        Valid
        Available
        Issued
        Modified
        Encoding schemes: DCMI Point, W3CDTF

The Dublin Core Publisher element is treated in the same way as Creator and Contributor with no further substructure or qualifiers defined for it. (Because of this lack of differentiation among Creator, Contributor and Publisher, there has been some discussion in DCMI to collapse them into one element. For the same reason, it has been ar-

gued that Creator and Contributor should be represented by one element.) This treatment of Publisher causes many difficulties in capturing essential data about the resource and in mapping to and from MARC. For example, the Publisher element cannot be associated with the place or date of publication (issuance). Moreover, since all elements in Dublin Core are repeatable there could be several publishers and several issuing dates; these cannot be associated with one another. To avoid such problems, MODS uses a "publicationInfo" element with subelements for place, publisher and various forms of dates. The new publicationInfo element is repeatable and thus can be used for multiple publishers with the appropriate place and date of publication. This treatment was developed for MODS because publication information is important in libraries; records are often initiated at the pre-publication stage and upgraded later, and library systems use records for many varied functions requiring this data, beginning with acquisition.

Date. The date element in Dublin Core is defined very broadly ("a date associated with an event in the life-cycle of a resource"). When using simple Dublin Core, the element is so broad that it has little use without knowing what type of date it is. MODS has no element for "unqualified" date as such, although an "otherDate" is being considered for the next revision. MODS provides several date subelements in the publicationInfo element: dateIssued, dateCreated, and dateCaptured. Dublin Core qualified provides refined types of dates and many of these are equivalent to MODS elements. But, as mentioned above, the date cannot be associated with the issuing body, which has ramifications both for mapping and for indexing.

Relation.

Table 3

Comparison of MODS RelatedItem with Dublin Core Relation

MODS

Related Item
Attributes: ID, type, xLink
Type values: preceding, succeeding, reproduction, original, host, constituent, series, related
  Subelements [ordered]
   TitleInfo
    Attributes: ID, type, authority, displayLabel, xlink
    Type values: abbreviated, translated, alternative, uniform
    *Subelements:**
     Title
     PartNumber
     PartName
     NonSort

Table 3 cont.

MODS

Name
> *Attributes:* ID, type, authority, xlink
> *Type values:* personal, corporate, conference
> *Subelements:**
>> NamePart
>>> *Attribute:* type (date)
>> DisplayForm
>> Affiliation
>> Role
>>> *Attribute:* authority
>> Description

PhysicalDescription
> Subelements:**
>> Form
>> InternetMediaType
>> Extent
>> DigitalOrigin
>> Note

Identifier
> *Attribute:* type (e.g. doi, isbn, issn)

Note
> *Attributes:* xlink, xml:lang, type

*Subelements reuse the definitions for the element by itself.

DUBLIN CORE (QUALIFIED)

Relation

   Subelements ("element refinements", treated in Dublin Core as elements; equivalent to MODS attribute type values)

> isVersionOf
> hasVersion
> isReplacedBy
> replaces
> isRequiredBy
> requires
> isPartOf
> hasPart
> isReferencedBy
> references
> isFormatOf
> hasFormat
> conformsTo
> *Encoding scheme:* URI

The Dublin Core element Relation is roughly equivalent to the MODS element relatedItem. Since Dublin Core elements have no substructure (DCMI has referred to these as "structured values" and they are being discussed), the metadata about a related item can only be expressed as free text and no parsing of elements is possible. Thus, retrieval can only be by keyword. Even more critical, a Dublin Core Relation can either point to the related item OR describe it; it can't do both. MODS has several subelements defined for relatedItem, including name, title, physicalDescription, identifier, and note that allow for more precise retrieval and identification. This substructure has proven particularly useful in digital library projects, where there is a need to describe the item as a whole as well as its subparts using relatedItem with type="constituent" (e.g. a CD with its constituent songs by different artists on separate tracks).

RelatedItem in MODS is mapped to the linking entry fields, series, and name/title fields in MARC; the parsing of the data is consequently not lost when converting from MARC to MODS, but it would be in Dublin Core.

Additional types of metadata. The Dublin Core element set does not provide for additional types of metadata such as administrative metadata, although there are standard ways for different communities to extend the element set. MODS, however, does provide data about the record itself, under recordInfo, for carrying out the necessary function of management of the metadata itself. In addition MODS has an extension element intended for local fields or for other schemas. The Library of Congress is developing a mechanism for a MODS record to specify basic holdings information about a resource by using the Z39.50 XML holdings schema.[10] This involves the use of elements from the Bath Profile for holdings information at the copy level.[11] Thus, the holdings information will be expressed as language based tags, as MODS is, and will be reusing an existing standard (Z39.50 holdings schema) that is based on MARC holdings. The holdings information will be included in the MODS extension element.

Experimentation with MODS

Since MODS was officially made available in June 2002 (although an earlier version was discussed by several groups of experts), experimentation is just beginning. In June 2002 MODS was frozen for six months trial use, although suggested additions are being listed on the MODS web site. The following will describe a few sample experiments.

AV Prototype Project. The Library of Congress' Audio-Visual Prototyping Project is exploring aspects of digital preservation for audio and video during 1999–2004. This collaborative project is developing approaches for packaging digital content, with a focus on metadata, and working with other Library of Congress (LC) projects to explore the design of repository systems that will store, maintain, and deliver digitally reformatted and "born-digital" recorded sound and moving image collections.[12] The project is an activity of various Library of Congress units with a contractor providing technical support.

The definition of intellectual (descriptive), administrative, and structural metadata are important aspects of the Prototyping Project. Most of the project's metadata is first

captured in a relational database at production time and subsequently transformed into an XML document for archiving and also to shape presentations for end users. The project is experimenting with METS for packaging the digital object and its metadata. It is currently implementing MODS for use as its descriptive metadata schema. Objects that already have descriptive cataloging records in one of the Library's databases may reuse the data after conversion from MARC to MODS with minimal data loss. In some cases, original resource description is provided and a MODS template is used.

Minerva Project. MINERVA (Mapping the Internet: Electronic Resources Virtual Archive; formally known as the Web Preservation Project) is an experimental pilot developed to identify, select, collect and preserve open-access materials from the World Wide Web.[13] The effort includes consensus building within the Library, joint planning with external bodies, studies of the technical, copyright and policy issues, the development of a long-term plan, and coordination of prototypes.

LC is collaborating with the Internet Archive (Alexa), SUNY, and the University of Washington to expand the project. The latter groups are assisting in identifying content and in using tools of their design to assign metadata descriptions to the web sites collected. This metadata database is then used to search, retrieve and analyze the archived collection of web sites. The contractors have been assisting with the collecting and archiving of Web sites focused on themes concerning Campaign 2000, September 11th, Winter Olympics 2002, and Election 2002. Metadata will be created for Web sites in the collection using the MODS schema because of its compatibility with MARC data. The MODS records will be used in the search and retrieval system for Minerva and will be converted to MARC, upgraded in some cases and added to the Library's online catalog. The Library also expects to experiment with METS to provide for additional metadata (e.g. preservation, administrative, etc.). Since some of these projects will be done in-house, LC's Network Development and MARC Standards Office is currently working on tools for the creation of MODS records and the conversion of MODS to MARC so that these records can be brought into the catalog.

University of Chicago Press. The University of Chicago Press received a grant from the Mellon Foundation to support the development of the Chicago Digital Distribution Center, which would be built upon its traditional distribution center. That funding provides for the scanning of 2500 backlist titles and the preparation of 2500 existing digital books from about a dozen client presses. The goals are to extend the lifetime of scholarly information and at the same time promote efficiencies and cost-savings by permitting publishers to produce smaller print runs.

The Press harvests MARC records to enhance searchability and retains these records for export to their client presses. Records will also be exported in ONIX or Dublin Core formats if these formats are desired. In addition it converts the MARC records into MODS, because it was felt that publishers would be better served by more concise descriptive information and the use of language-based tags. It intends to wrap the MODS record as descriptive metadata within the METS document to accompany other elements defined in the OAIS reference model.[14]

California Digital Library. The California Digital Library is establishing a generic METS repository infrastructure to help manage the digital objects in its control. A specific use of this repository is a project to provide searching and display of 1,500 records for books published online by the CDL on behalf of the University of California Press. Records are extracted from the union catalog and transformed to MODS, then inserted into the METS record. The METS records also include another metadata segment comprised of information extracted from a FilemakerPro database supplied by UC Press. Specified fields in these records are used for indexing and searching as well as in response to an Open Archives Initiative Harvesting Protocol query.

Conclusions

The library community has well-developed bibliographic description traditions that with some adjustment for digital resources, such as the MODS development exemplifies, will serve the digital future. The emergence of XML as a standard encoding language necessitates rethinking MARC for use in a new environment. By retaining much of the richness of the MARC element set and replacing the syntax with XML and the more friendly language-based tags, MODS allows for rich resource description that is compatible with the huge numbers of MARC bibliographic records existing in library systems. In addition, as an XML descriptive standard, it provides the flexibility to be combined with other XML based standards such as METS to satisfy needs for the digital library environment.

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Notes

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10.   "Z39.50 Holdings Schema, Version 1.2." Available: <http://lcweb.loc.gov/z3950/agency/defns/holdings.html> [November 11, 2002].

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13.   Library of Congress, "MINERVA: Mapping the Internet Electronic Resources Virtual Archive." Available: <http://lcweb.loc.gov/minerva/minerva.html> [November 11, 2002].

14.   Management Council of the Consultative Committee for Space Data Systems (CCSDS), "Reference Model for an Open Archival Information System (OAIS): Draft Recommendation for Space Data System Standards." Available: <http://www.ccsds.org/RP9905/RP9905.html> [November 11, 2002].